SECTION 16120
BUILDING WIRE AND CABLE - 600 V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions apply to this section.

1.2 SUMMARY

A. Section includes: Building wire and cable, underground feeder and branch circuit cable, and service entrance cable.

B. Only copper conductors are acceptable.

C. All wiring methods shall be conductors in conduit or conductors in cable trays unless specifically noted otherwise.

D. Related Sections
1. Section 16111, Conduit and fittings.
2. Section 16124, Splices and Terminations – Medium Voltage Cables.
3. Section 16131, Boxes.
4. Section 16196, Electrical Identification.
5. Section 16960, Electrical Testing.

1.3 REFERENCES

A. National Fire Protection Association (NFPA)
1. NFPA 70-1999, National Electrical Code.

B. National Electrical Manufacturer's Association, (NEMA)
1. NEMA WC5-1992, Thermoplastic-Insulated Wire and Cable.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and General and Supplementary Conditions.

B. All products require submittal for approval.

C. Submit specified test reports for approval.

1.5 QUALITY ASSURANCE

A. NFPA Compliance: Building wire and cable and components shall be designed, fabricated, and installed in compliance with NFPA 70A.

B. UL and NEMA Compliance: Provide wire and cable that are listed and labeled by UL and comply with applicable NEMA standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver material with factory protective crating and covering.

B. Lift and support containers with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Maintain required separation and avoid interference between cable and other work.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers – Wire and Cable
   1. Okonite
   2. BICC

B. Description: Single conductor insulated wire.

C. Conductor: Copper only.

D. Stranding:
   1. Wire No. 8 and larger: Stranded.
   2. Wire No. 10 AWG and smaller feeding lights and receptacles: Solid.
   3. Wire No. 10 AWG and smaller for motor leads and control wiring: Stranded.
   4. Standard stranding for cable sizes as follows: 7 strands up through No. 2; 19 strands from No. 1 through No. 4/0; 37 strands from 250 MCM through 500 MCM; and 61 strands from 600 MCM through 1000 MCM.

E. Insulation Voltage Rating: 600 V.

F. Insulation: Conductors in raceways; NFPA 70:
   1. THW or XHHW for sizes larger than No. 10 AWG.
   2. THHN/THWN for sizes No. 10 AWG and smaller.
   3. THHN/THWN for conductors enclosed in fluorescent lighting fixtures.

G. Color Coding:
   1. Grounding conductors may be bare or insulated as shown. Identify insulated conductors intended solely for grounding purposes by a continuous green color; a continuous green color with one or more yellow stripes; or by wrapping with green self-adhesive, vinyl-plastic electrical tape, Scotch 35, at terminal or junction points. Tape sufficient length of conductor nearest terminal or junction point so that grounding conductors are identifiable when covers are removed.
   2. Grounded (neutral) Conductors No. 2 AWG and Smaller: White insulation. Identify grounded conductors larger than No. 2 AWG at terminal or junction points by wrapping with white, self-adhesive, vinyl-plastic electrical tape, Scotch 35. Tape sufficient length of cable nearest terminal or junction point so that neutral conductors are identifiable when covers are removed.
   3. Color code system conductors as follows:
      a. Color and Number Coding for 120-V, Single-Phase, Two-Wire Systems
         1) Grounded neutral, white (first or only neutral in raceway, box, auxiliary gutter, or other types of enclosures).
         2) Grounded neutral, white with black stripe running entire length of insulation (when neutral is installed in raceway, box, auxiliary gutter, or other types of enclosures with another neutral).
         3) Grounding conductor, green.
         4) Ungrounded conductor, black with marker "120V-1PH."
      b. Color and Number Coding for 240/120-V, Single-Phase, Three-Wire Systems

1) Grounded neutral, white (first or only neutral in raceway, box, auxiliary gutter, or other types of enclosures).
2) Grounded neutral, white with brown stripe running entire length of insulation (when neutral is installed in raceway, box, auxiliary gutter, or other types of enclosures with another neutral).
3) Grounding conductor, green.
4) Ungrounded conductor, black with marker "240/120V-1PH-A."
5) Ungrounded conductor, red with marker "240/120V-1PH-B."

c. Color and Number Coding for 208Y/120-V, Three-Phase, Four-Wire Systems
1) Grounded neutral, white (first or only neutral in raceway, box, auxiliary gutter, or other types of enclosures).
2) Grounded neutral, white with red stripe running entire length of insulation (when neutral is installed in raceway, box, auxiliary gutter, or other types of enclosures with another neutral).
3) Grounding conductor, green.
4) Phase A (ungrounded) conductor, black with marker "208Y/120V-3PH-A."
5) Phase B (ungrounded) conductor, red with marker "208Y/120V-3PH-B."
6) Phase C (ungrounded) conductor, blue with marker "208Y/120V-3PH-C."

d. Color and Number Coding for 480Y/277-V, Three-Phase, Four-Wire Systems
1) Grounded neutral, white (first or only neutral in raceway, box, auxiliary gutter, or other types of enclosures).
2) Grounded neutral, white with yellow stripe running entire length of insulation (when neutral is installed in raceway, box, auxiliary gutter, or other types of enclosures with another neutral).
3) Grounding conductor, green with one or more yellow stripes.
4) Phase A (ungrounded) conductor, brown with marker "480Y/277V -3PH-A."
5) Phase B (ungrounded) conductor, orange with marker "480Y/277V -3PH-B."
6) Phase C (ungrounded) conductor, yellow with marker "480Y/277V -3PH-C."

e. Color and Number Coding for 480-V, Delta, Three-Phase, Three-Wire Systems
1) Grounding conductor, green with one or more yellow stripes.
2) Phase A (ungrounded) conductor, brown with marker "480VD-3PH-A."
3) Phase B (ungrounded) conductor, orange with marker "480VD-3PH-B."
4) Phase C (ungrounded) conductor, yellow with marker "480VD-3PH-C."

4. Furnish ungrounded single-conductor control circuit wiring a combination of colors other than white, gray, or green.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify interior of building is protected from weather.

B. Verify mechanical work likely to damage wire and cable is complete.

C. Verify that all raceways are at least one foot distance from all heat producing equipment.

3.2 PREPARATION

A. Pull wire and cable after conduit system is complete from pull point to pull point.

B. Swab raceway before installing wire.

C. Use Ideal Industries' "POLY-WATER" compound to pull nonarmored conductors.

3.3 APPLICATION

A. Wire and cable used in cable tray shall be TC rated conductors.
   1. Conductors smaller than # 1/0 shall be multi-conductor cable.
   2. Conductors size # 1/0 and larger shall be single conductors bound together in circuit groups.

B. Raceway may be conduit, boxes, gutters, or cable tray systems.

C. For 600-V, insulated cables, all sizes in all areas, buildings, spaces, etc. except for the CLO building the only acceptable conductor type shall be XHHW. THW, and THHN/THWN conductors shall not be used in areas other than in the CLO and in accordance with other restrictions contained here-in. Teflon and nylon materials, even for non-insulating functions, shall not be used in any way in the manufacture, assembly, or construction of these power cables.

3.4 INSTALLATION

A. Wiring
   1. Install products according to manufacturer's instructions.
   2. Pull conductors into raceway at same time.
   3. Use no wire smaller than No. 12 AWG for power and lighting circuits and no smaller than No. 14 AWG for control wiring.
   4. Use No. 10 AWG conductors for 20-A, 120-V branch circuit home runs longer than 75 ft and for 20-A, 277-V branch circuit home runs longer than 200 ft.
   5. Place equal number of conductors for each phase of a circuit in same raceway or cable.
   6. Splice in junction or outlet boxes.
   7. Train and lace wiring inside boxes, equipment, and panelboards.
   8. Make conductor lengths for parallel circuits equal.
   9. Bending Radius of Wire or Cable: Not less than minimum recommended by manufacturer.
   10. Maximum Pulling Tension and Sidewall Pressure of Wire or Cable: Not to exceed manufacturer's recommended values.

B. Cable
   1. Protect exposed cables from damage.
   2. Support cables in cable tray systems as they enter and leave the tray system.
   3. Use suitable cable tie wraps to securely attach cables to tray rungs.
   4. Spacing of bound circuit groups in cable tray shall comply with NEC.

3.5 FIELD QUALITY CONTROL

A. Visually check wire and cable for physical damage and proper connection.

B. Check for continuity and correctness of wiring and identification.

C. Perform check with direct current test device, such as bell, buzzer, or light.

D. For 600-V, insulated cables No. 4 AWG and larger installed as branch circuit conductors from 480-V switchgear, perform an "Insulation Resistance Test" using a Simpson Model 405 1000-V insulation tester.

1. Test with conductors disconnected at the equipment. Test between one conductor and ground, with the other conductors grounded. Test each conductor in same manner. Apply voltage for a minimum of 3 minutes or until reading reaches a constant value.
2. Replace conductor if resistance readings are less than 100 megohms and test replacement conductor.
3. More than one conductor may be listed on same cable test report if conductors listed are tested and accepted on same date. Include complete identification of feeder, Megger readings vs. time data, ambient temperature, and weather conditions on reports.

3.6 CLEANING

A. Clean Construction debris out of all accessible components of the raceway system prior to placing covers, devices or doors.

END OF SECTION 16120